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[Detailed Description of the Invention]

[0001]

[Field of the Invention]Especially this invention relates to the three-dimensional fabrication technology which generates a three-dimensional fabrication thing by combining powder material about three-dimensional fabrication technology.

[0002]

[Description of the Prior Art]In conventional three-dimensional fabrication equipment, to the layer of powder material, it dries, the binder to harden is breathed out from the head of an ink jet, etc., and there are some which form the combination of powder material one by one, and model a three-dimensional fabrication thing. In this three-dimensional fabrication equipment, for example, the following operations are performed and a three-dimensional fabrication thing is generated.

[0003]First, gypsum fibrosum and the powder material of starch are uniformly opened to a thin layer with a blade etc. Next, the head of an ink jet is scanned to the field which should be modeled in the thin layer of this powder material, and the binder hardened by desiccation is applied. The powder material of the field where this binder was applied is combined with a lower layer or an adjoining hardening field. The thin layer of powder material is formed one by one, and the process of applying a binder is repeated until modeling is completed. If modeling is completed, in order that the powder material of the field where a binder is not applied may maintain the state where it became independent separately, it can take out the three-dimensional fabrication thing combined with the binder.

[0004]

[Problem to be solved by the invention]However, above three-dimensional fabrication equipment is not enough as intensity -- the generated three-dimensional fabrication thing is weak against a shock -- while drying takes time, in order to apply the binder of the character hardened by desiccation and to combine powder material. For this reason, the tail end process for intensity reinforcement of making a reinforcement impregnate etc. is needed.

[0005]If it uses a binder with strong adhesive strength since the bore diameter of a nozzle part is very thin (generally 20 micrometers or less) in applying the above-mentioned binder using the head of an ink jet, it will harden by desiccation by a nozzle

part, and will be easy to start clogging. If such fault occurs, the powder material of the field which should apply a binder by the nozzle which caused blinding will not be combined, but it will become a factor to which the accuracy of form and intensity of a three-dimensional fabrication thing fall. For this reason, when using the head of an ink jet, only the binder of weak adhesive strength can be used but the intensity of the completed three-dimensional fabrication thing becomes low.

[0006]In light of the above-mentioned problems, an object of this invention is to provide the three-dimensional fabrication technology which can generate the three-dimensional fabrication thing whose intensity improved.

[0007]

[Means for solving problem]In order to solve above-mentioned SUBJECT, invention of Claim 1, A stratification means to form the layer of the powder material which is three-dimensional fabrication equipment which generates a three-dimensional fabrication thing by combining powder material, and has (a) thermal fusibility one by one, (b) A grant means to give the liquid which absorbs electromagnetic wave energy to the selected area in the layer of said powder material, (c) When it has a radiation means which emits electromagnetic waves to said liquid given to said powder material, and said liquid is heated and said powder material carries out melting by said electromagnetic wave, the combination of said powder material is formed.

[0008]In the three-dimensional fabrication equipment which invention of Claim 2 requires for invention of Claim 1, said radiation means emits said electromagnetic wave for every layer of said powder material formed one by one.

[0009]In the three-dimensional fabrication equipment which invention of Claim 3 requires for invention of Claim 1 or Claim 2, said liquid contains a coloring carrier.

[0010]The stratification process of forming the layer of the powder material which invention of Claim 4 is the three-dimensional fabrication method which generates a three-dimensional fabrication thing by combining powder material, and has (a) thermal fusibility one by one, (b) The grant process of giving the liquid which absorbs electromagnetic wave energy to the selected area in the layer of said powder material, (c) When it has the radiation process of emitting electromagnetic waves, to said liquid given to said powder material, and said liquid is heated and said powder material carries out melting by said electromagnetic wave, the combination of said powder material is formed.

[0011]In the three-dimensional fabrication method concerning invention of Claim 4,

invention of Claim 5 emits said electromagnetic wave for every layer of said powder material formed one by one in said radiation process.
[0012]In the three-dimensional fabrication method which invention of Claim 6 requires for invention of Claim 4 or Claim 5, said liquid contains a coloring carrier.
[0013]
[Mode for carrying out the invention]<1st embodiment <important section composition of three-dimensional fabrication equipment>> drawing 1 is a schematic view showing the three-dimensional fabrication equipment 100A concerning a 1st embodiment of this invention.
[0014]The three-dimensional fabrication equipment 100A is provided with the control section 10A, and the ink grant part 20 and the modeling part 30 which are electrically connected to the control section 10A, respectively, the powder feed zone 40, the powder diffused part 50 and the electromagnetic-wave-irradiation part 60, and is constituted.
[0015]The control section 10A is provided with the following.
Computer 11.
The drive control section 12 electrically connected with the computer 11.

[0016]The computer 11 is a common desktop computer etc. which equip an inside with CPU, a memory, etc. and are constituted. This computer 11 uses three-dimensional-shaped shaping material as formed data, data-izes it, and outputs the cross section data produced by slicing it on the thin section object of many parallel layers to the drive control section 12.
[0017]The drive control section 12 functions as a control means which drives the ink grant part 20, the modeling part 30, the powder feed zone 40, the powder diffused part 50, and the electromagnetic-wave-irradiation part 60 to each. moreover -- setting the drive control section 12 in the modeling part 30 by giving a driving command to above-mentioned each part based on the cross section data, if cross section data is acquired from the computer 11 -- powder material -- much more -- each time -- generalization control of the operation which forms powdered combination one by one is carried out.
[0018]The ink grant part 20 is provided with the XY direction moving section 23 to which the nozzle head 22 which makes the ink solution in the tank section 21 and the tank section 21 breathe out, and the nozzle head 22 are moved in a level XY plane, and the actuator 24 which drives the XY direction moving section 23.
[0019]The tank section 21 is provided with two or more tanks (this example four tanks)

21a-21d in which the ink solution of a color different, respectively is accommodated. Specifically, the ink solution (below, it is only called "ink") which dissolved the three primary colors of Y (yellow), M (Magenta), and C (cyanogen) which are coloring carriers, and the water soluble inks of W (white) in water is accommodated in each tank 21a-21d.

[0020]It is being fixed to the lower part of the XY direction moving section 23, and the nozzle head 22 is united with the XY direction moving section 23, and freely movable in an XY plane. The nozzle head 22 was provided with regurgitation nozzle 22 a-d of the number of tanks and the same number of the tank section 21, and has connected each regurgitation nozzle 22 a-d with tank 21 a-d by the four tubes 25. Each regurgitation nozzle 22 a-d is a nozzle which carries out the regurgitation (jet) of each ink as minute droplet, for example with an ink jet system etc. The regurgitation of the ink by each regurgitation nozzle 22 a-d is individually controlled by the drive control section 12, and the ink breathed out from each regurgitation nozzle 22 a-d adheres to the powder layer 82 of the modeling part 30 provided in the position which counters the nozzle head 22.

[0021]The XY direction moving section 23 is provided with the moving section main part 23a and the guide rail 23b. While the reciprocation moving to the direction of X is possible for the moving section main part 23a along with the guide rail 23b, the reciprocation moving to the direction of Y is possible for it. Therefore, the nozzle head 22 can be moved in the flat surface specified by the XY direction moving section 23 by the X-axis and a Y-axis. That is, based on the driving command from the drive control section 12, it is in the driving range in the flat surface, and the nozzle head 22 can be moved to arbitrary positions.

[0022]The modeling part 30 is provided with the Z direction moving section 33 which moves the modeling stage 32 provided in the center inside the concave part of the modeling part main part 31 and the modeling part main part 31 which has a concave part, and the modeling stage 32 to a Z direction, and the actuator 34 which drives the Z direction moving section 33.

[0023]The modeling part main part 31 has achieved the duty which provides the workspace for generating a three-dimensional fabrication thing. The modeling part main part 31 has the powder temporary placing part 31b which holds temporarily the powder supplied to the upper part from the powder feed zone 40.

[0024]The modeling stage 32 had rectangle type form in XY section, and the side is in contact with the vertical wall 31a of the concave part in the modeling part main part 31. And the three dimensional space WK of the rectangular parallelepiped shape formed

with this modeling stage 32 and the vertical wall 31a of the modeling part main part 31 functions as base space for generating a three-dimensional fabrication thing.
[0025]The Z direction moving section 33 has the bearing bar 33a connected with the modeling stage 32. And the bearing bar 33a becomes movable [the Z direction of the modeling stage 32 connected with the bearing bar 33a], when perpendicularly moved by the actuator 34.
[0026]The powder feed zone 40 is provided with the following.
The deadline board 42 formed in the exit of the tank section 41 and the tank section 41.
The actuator 43 to which the deadline board 42 is made to slide by instructions of the drive control section 12.

[0027]The powder material of the thermally fusible resin used as a material for the tank section 41 to generate a three-dimensional fabrication thing is accommodated. In order to carry out melting of this powder material with the water which generated heat so that it might mention later, it is preferred to use the boiling point of water, i.e., the thing which carries out thermofusion below about 100 **.
[0028]The deadline board 42 performs supply and a stop of the powder which can slide now horizontally (the direction of X) and is accommodated in the tank section 41 to the powder temporary placing part 31b of the modeling part 30.
[0029]The powder diffused part 50 is provided with the following.
Blade 51.
The guide rail 52 which regulates operation of the blade 51.
The actuator 53 to which the reciprocation moving of the blade 51 is made to carry out horizontally (the direction of X).

[0030]The blade 51 is long in the direction of Y, and it has the form of edge shape where the lower tip sharpened. Y lay length of the blade 51 is the length which can cover the width of the direction of Y in the three dimensional space WK. The vibration mechanism in which minute vibration is given to a blade may be added so that powder with the blade 51 can be diffused smoothly.
[0031]The actuator 53 has the vertical-drive part 53a to which the rise and fall movement of the blade 51 is made to carry out perpendicularly (Z direction), and the level actuator 53b to which the reciprocation moving of the blade 51 is made to carry out horizontally (the direction of X). And when the vertical-drive part 53a and the level actuator 53b drive

based on the instructions from the drive control section 12, it becomes movable [the direction of X of the blade 51, and a Z direction].

[0032]The electromagnetic-wave-irradiation part 60 is provided with the following.

The antenna 61 for electromagnetic wave irradiation.

Electromagnetic wave generation part 62.

[0033]The antenna 61 for electromagnetic wave irradiation is an antenna for emitting electromagnetic waves to the powder material laminated on the modeling stage 32. It is preferred to generate the electromagnetic waves (for example, electromagnetic waves of a microwave band) of a specified wavelength suitable for making moisture generate heat efficiently from this antenna 61 for electromagnetic wave irradiation.

[0034]The electromagnetic wave generation part 62 has a circuit for generating electromagnetic waves with the antenna 61 for electromagnetic wave irradiation.

[0035]<Operation of three-dimensional fabrication equipment 100A> drawing 2 is a flow chart which shows fundamental operation of the three-dimensional fabrication equipment 100A. Hereafter, the basic motion is explained with reference to the figures.

[0036]In Step S1, the model data in which the computer 11 expressed the three-dimensional fabrication subject in which color patterns etc. were given to the surface is created. The color three dimensional object model data created by general 3-dimensional CAD modeling software can be used for the formed data which becomes a basis for modeling. It is also possible to use the formed data and the texture which were measured with the three-dimensional shape inputting device.

[0037]In model data, there is a thing to which the color information is given only on the surface of the three dimensional object model, or a thing to which the color information is given to the inside of a model. It is possible to use only the color information of a model surface when modeling also in the case of the latter, and it is possible to also use the color information inside a model. For example, when generating three-dimensional fabrication things, such as a human body model, it is to paint by a different color for every internal organs, and the color information inside a model is used in that case.

[0038]In Step S2, the computer 11 generates the cross section data for every section which sliced the modeling subject horizontally from the above-mentioned model data. The section object sliced in the pitch (thickness t) of the powder laminated from model data which is further equivalent to the thickness of a part is cut down, and formed data and coloring data are created. The pitch to slice can be changed in a prescribed range

(the range of the thickness which can combine powder).
[0039]Drawing 3 is a figure showing an example of the cross section data generated at Step S2. As shown in drawing 3, section objects including a color information are cut down from model data, and it subdivides in the shape of a lattice. It is treated like the bit map of a two-dimensional picture, and is changed into the bit map information for every color. This bit map information is the information in consideration of gradation etc.
[0040]In Step S3, the information about the powdered lamination thickness (slice pitch in the case of cross-section-data creation) and the number of laminations (the number of section data sets) at the time of modeling a modeling subject is inputted into the drive control section 12 from the computer 11.
[0041]It is the operation performed about the following step S4 or below when the drive control section 12 controls each part. Drawing 4 is a key map explaining these operations. Below, it explains, referring to the figure.
[0042]In step S4, in order to form the powdered combination of the Nth layer (N= 1, 2, --) in the modeling stage 32, based on the above-mentioned thickness t inputted from the computer 11, only the distance equivalent to the thickness descends and the modeling stage 32 is held by the Z direction moving section 33. In an initial state, the modeling stage 32 will be located in the same height position as the upper bed position of the modeling part 30, and only the distance according to the thickness t will descend from there. And the modeling stage 32 descends gradually by one layer only a distance [the whole formation] by powder material corresponding to the thickness t one by one. A space for this to form the layer of powder new above the powder layer which powder material deposited on the modeling stage 32 by one layer can be formed.
[0043]In Step S5, while supplying powder material from the powder feed zone 40, thin layer formation for one layer of the powder material which turns into material in modeling of a three-dimensional fabrication thing is performed by moving the blade 51 toward the direction of +X.
[0044]In operation of this step S5, as shown in drawing 4 (a), powder material is first dropped from the powder feed zone 40 in the powder temporary placing part 31b of the modeling part main part 31. And as shown in drawing 4 (b), it descends so that the lowest point of the blade 51 may serve as an upper bed part of the modeling part 30, and a same height position, and movement in the direction of +X is performed in the state. By this, uniform thin layer formation of powder material with the powder feed zone 40 and the blade 51 will be performed correctly.

[0045]It has avoided that more quantity of the powder material supplied by one layer at the time of formation (while performing one movement which met in the direction of +X) is set as formation a little rather than a complement by one layer, and the shortage of powder produces them from the powder feed zone 40 in the arbitrary positions in modeling space. For this reason, although powder material will remain after formation by one layer, the surplus powder materials are collected and are available again.
[0046]In Step S6, as shown in drawing 4 (c), the nozzle head 22 moves in the direction of +X, and carries out the regurgitation of the ink of each color to the powder layer extended from each regurgitation nozzle 22 a-d based on the control signal from the drive control section 12. At this time, when the drive control section 12 gives a control signal to the nozzle head 22 based on cross section data (refer to drawing 3), the ink of each color is applied to the selected area which should be modeled.
[0047]Here, ink is applied to the coloring field near the surface of a three-dimensional fabrication thing by giving a control signal from the drive control section 12 to the nozzle head 22 based on the coloring data (refer to drawing 3) of YCMW. By this, it can paint to a request to a three-dimensional fabrication thing.
[0048]Although what is necessary is just to carry out the mixed colors of the three primary colors of Y, M, and C generally in order to paint, in order to express the shade (gradation) of a color, it becomes effective to breathe out and carry out the mixed colors of the white ink in addition to the three primary colors. With a common printer, since the character and the picture are printed on white paper with ink, a toner, etc., if the white of the paper used as a base material is used, white ink is not required, and the shade of each color component can be theoretically expressed only by using three colors of Y, M, and C. However, when the color of the powder used as the material of three-dimensional fabrication is not white, it becomes effective especially to use white ink.
[0049]Thus, an example of the discharge mode of the ink in the case of displaying the shade at the time of painting in a three-dimensional fabrication thing is explained.
[0050]Drawing 5 is a figure showing an example of the gray scale representation about cyanogen. the gradation data of the multiple value contained in cross section data when predetermined gray scale conversion is performed in the drive control section 12 -- a basic dot region (minimum rectangular [of drawing 5]) -- each time -- it is changed into binary data. This binary data serves as information for carrying out ON/OFF control of nozzle head 22 a-d which carries out the regurgitation of the ink. In displaying light cyanogen, cyanogen is breathed out to one basic dot region among the matrices arrayed

of 2x2, and it carries out the regurgitation of the white to other basic dot regions. In displaying deep cyanogen, it carries out the regurgitation of the cyanogen to the whole basic set field. Thus, by changing the regurgitation rate of the ink of cyanogen and a white's ink to a basic set field, it becomes possible to express appropriately the gradation change from cyanogen to light deep cyanogen.

[0051]Next, drawing 6 is a figure showing an expressional example which changes from light cyanogen to light yellow. The left end of drawing 6 is a discharge pattern of C and W at the time of expressing light cyanogen, and a right end is a discharge pattern of Y and W at the time of expressing light yellow. By changing gradually the rate which carries out the regurgitation of C into a basic set field, and Y and W as it is shown in drawing 6, when making it change from light cyanogen to light yellow through the mixed color of cyanogen and yellow, it becomes possible to express change of such a color.

[0052]Drawing 7 shows that in which two or more basic set fields for the above-mentioned coloring gathered. Drawing 7 (a) shows a discharge pattern of C and W, and drawing 7 (b) shows concretely a coloring form expressed with a discharge pattern of drawing 7 (a). When the drive control section 12 controls a discharge pattern to be shown in drawing 7, it becomes possible to perform coloring in a modeling process of a three-dimensional fabrication thing.

[0053]In Step S7, it is judged whether lamination of powder material was completed, i.e., was the number of laminations inputted at Step S3 reached?. Here, when lamination is not completed, operation which forms the new powder layer of the N+1st layer in the Nth layer upper part is performed.

[0054]In Step S8, as shown in drawing 4 (d), ink irradiates with electromagnetic waves from the antenna 61 for electromagnetic wave irradiation to the powder material applied and laminated. Here, by vibrating the water molecule of the ink adhering to powder material, and making it generate heat with electromagnetic wave energy, the powder material to which ink adhered carries out thermofusion, and is combined. In order that powder material is not combined through a heterogeneous substance called a binder, but the powder material itself may carry out melting and it may join mutually together by this, intensity will improve.

[0055]The powder material in which electromagnetic waves were irradiated is made to cool naturally after operation of Step S8. The solid part 81 can be acquired after this cooling by separating the solid thing 81 from an uncombined powder material in which ink is not applied. Uncombined powder materials may be collected and may be again

used as a powder material.
[0056]Thus, when only the predetermined number of laminations repeats the operation shown in drawing 4 (a) - (c), The powder layer by which coloring was carried out with each color ink on the modeling stage 32 is laminated one by one, and the solid thing 81 of a modeling subject will be modeled on the modeling stage 32 by finally, irradiating with electromagnetic waves, as shown in drawing 4 (d).
[0057]In order that the powder material in which ink was applied may carry out melting and may join together by the exposure of electromagnetic waves by operation of the above three-dimensional fabrication equipment 100A, the intensity of the solid thing generated will improve.
[0058]The solid thing as a functional part which needs elasticity, such as a spring, for powder material of each other in order to make it join together, melting and can be generated, and the scope about solid thing modeling is expanded.
[0059]Since time to irradiate with electromagnetic waves becomes shorter than the time which dries a binder, it can attain improvement in the speed of modeling.
[0060]Since itself are solution, such as ink without an adhesive property, the liquid which carries out the regurgitation from a regurgitation nozzle does not generate clogging in a regurgitation nozzle by desiccation, but its reliability in modeling improves.
[0061]Since the thermally fusible resin used as a powder material has less condensation by humidity than powder materials used as an object stiffened with a binder, such as starch and gypsum fibrosum, it becomes easy to save it etc.
[0062]Although the three-dimensional fabrication equipment 100B concerning a 2nd embodiment of <2nd embodiment> this invention is similar with the three-dimensional fabrication equipment 100A of a 1st embodiment, the control sections 10B differ.
[0063]That is, the program for the control section 10B to perform operation of the three-dimensional fabrication thing 100B explained below is stored, and this point is different from a 1st embodiment.
[0064]As for the colored ink of YCM in tank 21 a-c, it is more preferred than the white ink in the tank 21d to make a moisture content small. Since the moisture of white ink absorbs electromagnetic waves and generates heat, this is used so that it may mention later, but it is because other colored ink is used only for coloring.
[0065]<Operation of three-dimensional fabrication equipment 100B> drawing 8 is a flow chart which shows fundamental operation of the three-dimensional fabrication equipment 100B. Unlike a 1st embodiment, it will irradiate with electromagnetic waves for every

powder layer, but this operation explains details of that operation below.

[0066]About operation to Steps S11-S13, the same operation as Steps S1-S3 shown in a flow chart of drawing 2 is performed.

[0067]It is the operation performed about Step S14 or below when the drive control section 12 controls each part. Drawing 9 is a key map explaining these operations. Below, it explains, referring to the figure.

[0068]In Step S14, in order to form the powdered combination of the Nth layer (N= 1, 2, --) in the modeling stage 32, based on the thickness t inputted from the computer 11, only the distance equivalent to the thickness descends and the modeling stage 32 is held by the Z direction moving section 33.

[0069]In Step S15, like a 1st embodiment, while supplying powder material from the powder feed zone 40, thin layer formation for one layer of the powder material which turns into material in modeling of a three-dimensional fabrication thing is performed by moving the blade 51 toward the direction of +X (refer to drawing 9 (a) and drawing 9 (b)).

[0070]In Step S16, as shown in drawing 9 (c), the nozzle head 22 moves in the direction of +X, and carries out the regurgitation of the white ink to the powder layer extended from each regurgitation nozzle 22d based on the control signal from the drive control section 12. At this time, when the drive control section 12 gives a control signal to the nozzle head 22 based on cross section data (refer to drawing 3), white ink is applied to the selected area which should be modeled.

[0071]Here, after forming the form of a solid thing at the following step S17, the regurgitation only of the white ink is carried out in order to use the ground at the time of carrying out coloring by other colors in Step S18.

[0072]In Step S17, as shown in drawing 9 (d), it irradiates with electromagnetic waves from the antenna 61 for electromagnetic wave irradiation to the powder material in which white ink was applied at Step S16. By this, the combination of the powder material to the thin layer for one layer formed at Step S15 can be generated.

[0073]In Step S18, as shown in drawing 9 (e), the nozzle head 22 moves in the direction of -X, and carries out the regurgitation of the ink of colored, i.e., YCM, each color to the powder layer extended from each regurgitation nozzle 22 a-c based on the control signal from the drive control section 12. At this time, when the drive control section 12 gives a control signal to the nozzle head 22 based on the coloring data (refer to drawing 3) of cross section data, ink colored [each] is applied to the combination of powder material, and coloring is given. Here, since ink is applied to the powder material after being

combined, the blot in coloring can be controlled.
[0074]In Step S19, it is judged whether modeling of the three-dimensional fabrication thing was completed. Here, when modeling is not completed, operation which forms the combination of the new powder of the N+1st layer in the Nth layer upper part is performed. And if modeling of a three-dimensional fabrication thing is completed, the combination (three-dimensional fabrication thing) of the powder material combined in ink can be taken out by separating the powder material of independent each which ink is not given and has not been united.
[0075]By operation of the above three-dimensional fabrication equipment 100B, the same effect as the three-dimensional fabrication equipment 100A of a 1st embodiment is demonstrated. In the three-dimensional fabrication equipment 100B, since it irradiates with electromagnetic waves for each layer of powder material, the heated steam moving up and carrying out melting of the upper powder material will be lost, and the accuracy of form of a solid thing will improve.
[0076]In the three-dimensional fabrication equipment 100B, a regurgitation nozzle is added and it may be made to carry out the regurgitation of the water-white water besides the ink of YMCW each color. In this case, water-white water will be breathed out at the above-mentioned step S16, and coloring will be carried out in the ink of YMCW each color at Step S18. Thereby, although an equipment configuration becomes somewhat complicated, the amount of consumption of white ink can be stopped.
[0077]The powder material of the <modification> O above of using thermally fusible resin is not indispensable, and the material in which the surface is coated with thermally fusible resin, for example may be used for it. The intensity of a solid thing can be improved because materials weld with heat also in this case.
[0078]Thermal fusibility may have as a powder material besides resin (for example, chocolate powder etc.).
[0079]O About coloring in each of above-mentioned embodiments, it is not indispensable to apply the trichromatic ink of Y, M, and C, and it may apply the three primary colors of R (red), G (green), and B (blue).
[0080]Painting in ink is not indispensable and it may paint to it with the solution which made the toner etc. contain.
[0081]O About the liquid applied to powder material, it is not indispensable that it is the solution which melted water or water soluble inks, and it may use the liquid which absorbs electromagnetic wave energies, such as an oil and alcohol. In this case, the

powder material which carries out thermofusion below in the boiling point of the liquid to be used is selected.

[0082]O It is not indispensable to irradiate with electromagnetic waves for each layer, and it may be made to irradiate with electromagnetic waves at 1 time of a rate for two or more powder material layers of every about a 2nd above-mentioned embodiment.

[0083]O In a 1st embodiment, the form which irradiates with an electron wave for each layer (two or more powder material layers of every [or]) may be sufficient. In this case, although a blot of a color occurs somewhat, since the scanning frequency of a nozzle head is reduced, modeling time can be shortened. A three-dimensional fabrication thing with sufficient accuracy of form will be obtained.

[0084]

[Effect of the Invention]As explained above, according to invention of Claim 1 thru/or Claim 6, the liquid which absorbs electromagnetic wave energy is given to the selected area in the layer of the powder material which has thermal fusibility, and electromagnetic waves are emitted to it to the given liquid. As a result, when a liquid is heated and powder material carries out thermofusion by electromagnetic waves, the three-dimensional fabrication thing whose intensity improved is generable.

[0085]In particular, in invention of Claim 2 and Claim 5, in order to emit electromagnetic waves for every layer of the powder material formed one by one, the influence of steamy which a liquid evaporates and goes up can be inhibited, and the accuracy of form of a three-dimensional fabrication thing improves.

[0086]In invention of Claim 3 and Claim 6, since a liquid contains a coloring carrier, it can paint easily to a three-dimensional fabrication thing.

[Claim(s)]

[Claim 1]A stratification means to form a layer of powder material which is three-dimensional fabrication equipment which generates a three-dimensional fabrication thing by combining powder material, and has (a) thermal fusibility one by one, (b) A grant means to give a liquid which absorbs electromagnetic wave energy to the selected area in a layer of said powder material, (c) Three-dimensional fabrication equipment when it has a radiation means which emits electromagnetic waves to said liquid given to said powder material, and said liquid is heated and said powder material carries out melting by said electromagnetic wave, wherein combination of said powder material is formed.

[Claim 2]Three-dimensional fabrication equipment, wherein said radiation means emits said electromagnetic wave for every layer of said powder material formed one by one in the three-dimensional fabrication equipment according to claim 1.

[Claim 3]Three-dimensional fabrication equipment, wherein said liquid contains a coloring carrier in the three-dimensional fabrication equipment according to claim 1 or 2.

[Claim 4]A stratification process of forming a layer of powder material which is the three-dimensional fabrication method which generates a three-dimensional fabrication thing by combining powder material, and has (a) thermal fusibility one by one, (b) A grant process of giving a liquid which absorbs electromagnetic wave energy to the selected area in a layer of said powder material, (c) A three-dimensional fabrication method when it has a radiation process of emitting electromagnetic waves, to said liquid given to said powder material, and said liquid is heated and said powder material carries out melting by said electromagnetic wave, wherein combination of said powder material is formed.

[Claim 5]A three-dimensional fabrication method emitting said electromagnetic wave for every layer of said powder material formed one by one in said radiation process in a three-dimensional fabrication method according to claim 4.

[Claim 6]A three-dimensional fabrication method, wherein said liquid contains a coloring carrier in a three-dimensional fabrication method according to claim 4 or 5.